gable rivers. They are of an inferior order to the slopes of glaciers, whereas they are of the same order as those of the most impetuous torrents. These slopes, without any exception, would be very considerable for rivers of a few yards in depth, and they would be *enormous* for masses of water having a section equal to those determined by the limits of the erratic zone in the valleys of the Alps, sections having a depth of from 800 to 1000 yards! With such slopes and such sections, the currents of water would have *frightful* rapidity; currents of mud, even the most viscid, forming *nants sauvages* on a gigantic scale, would also acquire enormous rapidity, and be capable of prodigious effects.

The rapidity of a liquid augments with the slope of its surface, and with the depth of its section; of this the rapidity acquired by all rivers when flooded is a demonstrative proof. On the contrary, it is doubtful if a very thick glacier experiences less difficulty than a thinner one in its movement over a gentle slope. This is an essential point to which attention ought to be paid in the comparison of these two classes of transporting agents. Acquired velocity has no share in the movement of glaciers.

Such a difference exists between the *régime* of ice in movement and that of running water, that by preparing *three comparative tables*, one of the above-mentioned features of glaciers, another of those of streams of water, and a third of those of erratic phenomena, a powerful aid would be obtained in determining the cause of the last.

Description of the genus Cuma, and of Two New Genera nearly allied to it. By Henry D. S. Goodsir, Esq. Communicated by the Author.* (No V.) With Plates.

During the summers of 1841 and 1842, I obtained a number of crustaceous animals, which I arranged promiscuously under the genus *Cuma* of M. Edwards, it being my intention

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* Read before the Wernerian Natural History Society, Dec. 10, 1842.

to publish them at that time under this arrangement. I waited, however, until it could be satisfactorily proved whether they were perfect animals, or, according to the suspicions of M. Edwards, merely the larvæ of some Decapodous Crustacea. I have now satisfied myself that they are perfect animals, and at the same time have discovered the types of two new genera, which places the group in a still more interesting point of view.

I have applied the name *Bodotria* to one of these genera, and *Alauna* to the other; the former being the ancient name of the Firth of Forth, at the mouth of which all these animals were got; and the latter, the ancient name of the river Forth.

The latter of these genera (*Alauna*) may be the genus *Condylurus* of Latreille, as I have never seen that author's description; but whether it be so or not there cannot be any danger in applying the name *Alauna*, as *Condylurus* had been previously used amongst the Mammalia.

As I had a greater number of specimens of the *Cuma Edwardsii* than of any of the others, I have been enabled to make out the structure of that species with greater minuteness.

These animals are very like small prawns in their general appearance; but they bear perhaps in this respect a greater likeness to the species of the genus *Nebalia* than to any other known Crustaceans.

The shell is hard and brittle, cracking under pressure. All the species are of a pale straw colour. The thoracic portion of the body is large and swollen; it is composed of six segments; the abdomen is longer, and is composed of seven segments.

M. Edwards, in his Memoir on the genus *Cuma*, published in the 13th vol. of the Ann. des Sc. Nat., considers that the whole of the first and largest segment of the body constitutes the head. In all the specimens which I have dissected, I have found a suture running across this segment, immediately before the middle part of it; this is observed very distinctly in the *Cuma trispinosa*, in the *Bodotria arenosa*, and also in the genus *Alauna*. The first of these parts I consider to be the head; the second part as the first thoracic segment. To the first we find attached the rostrum, eyes, antennæ, organs of

the mouth, and footjaws four in number. The second part bears the first pair of true ambulatory legs; these legs constituting (according to M. Edwards) the third pair of footjaws.

The second thoracic segment is quite obsolete in M. Edward's species (*Cuma Audouinii*); it is but slightly observed in the *C. Edwardsii*; in the *C. trispinosa*, however, it becomes quite apparent, being of considerable breadth at the dorsal portion. In the *Alauna rostrata* also, we find this segment quite developed throughout its whole extent, and the second pair of thoracic legs arising from it.

These two thoracic segments (the first and second) bear the compound legs in the genera *Cuma* and *Bodotria*, in which two genera the four following segments bear the four pairs of simple legs. In the genus *Alauna*, however, we find a different arrangement, there being an equal number of simple and compound legs, three pairs of each.

The eyes in this tribe of animals are exceedingly small; they are pedunculated, but sessile, and are placed very close together; they are situated near the posterior part of the head, a short distance behind the rostrum, and on the mesial line. They are covered by the shell, owing to which, and their proximity to one another, the animal is at first sight apt to be considered as monoculous. The rostrum is short and truncated in the genus *Cuma;* is almost altogether awanting in *Bodotria*, but is well developed in *Alauna*, being of considerable length and pointed.

The antennæ undergo considerable changes in the different genera of this tribe. In *Cuma* we find the superior antennæ consisting of a single scale-like joint, armed with a number of strong spines; the inferior antennæ* are five-jointed, being in general very little longer than the rostrum. In *Bodotria* the superior antennæ are altogether obsolete, and the inferior antennæ are very short. In *Alauna* again, we find the antennæ more developed; the superior† consisting of a single jointed peduncle, and a long multiarticulate filament which is covered with hairs. The inferior pair‡ are eight or nine-jointed, and are somewhat larger than the rostrum. The organs of the mouth consist of one pair of maxillæ,§ three

* Plate II. Fig. 8. † Pl. IV. Fig. 3. ‡ Pl. IV. Fig. 4. § Pl. II. Fig. 2.

pairs of mandibles,* and two pairs of foot-jaws.† These last organs will be found minutely described under *Cuma Edwardsii*, the species which I have been enabled to examine most minutely.

The true legs may be classed into compound and simple. The compound legs, as we have already stated, are four in number in the genera *Cuma* and *Bodotria*; but six in *Alauna*. The first, or compound legs, are divided into two parts, the anterior or ambulatory, and the posterior or natatory. The simple legs are much shorter than the compound, and are more adapted for prehension; but they are unarmed with claws, and are seldom used for this purpose.

The abdomen is moniliform, seven jointed, in all the genera. The last joint is very small in the genera *Cuma* and *Bodotria*; but in *Alauna* we find this segment very much developed. All the genera have the sixth abdominal segment armed with a pair of long bifurcated styles. The genera *Cuma* and *Alauna* are quite free of appendages to the other abdominal segments; but in *Bodotria* we find that all the abdominal segments are armed with a pair of bifurcated appendages.‡

Owing to the opacity of the shell, I have not been able as yet to make out the minuter parts of the anatomy of these animals. The intestinal canal consists of a long straight tube, considerably dilated as it passes through the thoracic portion of the body; when it reaches the abdominal portion it suddenly becomes much narrower.

The anal aperture is found in the seventh abdominal segment.

The branchiæ§ are situated on each side of the thorax, immediately above the insertions of the legs, and approach, in their comb-like appearance, to those of the higher Crustacea. Interiorly, each of them is connected with the superior foot-jaws, and excepting that connection, lies apparently quite free in a sac formed by the reflection of a thin transparent membrane, which lines the internal surface of the thorax. The superior part of the branchiæ consists of one continuous piece, which is bent in a hook-like manner at its posterior extremity; the branchiæ themselves arise from

* Pl. II. Figs. 3, 4, 5. † Pl. II. Fig. 7. ‡ Pl. II. Fig. 17. § Pl. IV. Fig. 11.

the inferior edge of this part, and are about sixteen or seventeen in number; they are not laminated like those of the higher Crustacea, but consist of one large piece, which is apparently composed of a great number of cells.

The organs of generation are not apparent in the male, but in the female, and, especially when she is loaded with spawn, these organs are at once perceptible. They are very similar in their structure and appearance to the same parts in the female *Mysis*. They consist of four scales, which arise from the inferior edge of the thoracic segments. These scales are of an irregular oval shape, concave internally, and convex externally, and they are overlapped by one another.* The eggs are of considerable size, and of a bright straw colour. It is from the genus *Cuma* only that these observations were taken in regard to the organs of generation.

When a portion of the skin, or shell rather, is placed under the microscope, it presents a very beautiful appearance; it apparently consists of a great number of nuclei, arranged in some degree of order. These nuclei are stellated, and here and there larger nuclei may be observed, the edges of which are quite smooth.†

The structure of these animals is so peculiar, as to render the assignation (at present) of a proper place in a natural arrangement of the class, a point of very considerable difficulty. This arises in a great measure, without doubt, from our very limited knowledge of the class. I rather think, however, that they should be ranged among the lower *Decapoda macroura*.

Genus Cuma (*Edwards*).

Generic Characters.—The superior antennæ are single-jointed, and scale-like; the inferior antennæ are five-jointed. The caudal styles have the double terminal scales biarticulate, the last of which is always the shortest.

Cuma Edwardsii, mihi.‡

C.—With the superior antennæ rhomboidal; with the ambulatory division of the first pair of legs, with the first joint bent at an obtuse angle; with the thumb-like process single-jointed, and with the last joints clavate. Length, 4 lines. Hab. Frith of Forth.

Description.—The whole animal is of a fine straw colour, with a delicate tinge of pink, which is brighter in certain lights; the shell is quite

* Plate IV. Fig. 12. † Plate II. Fig 18. ‡ Plate II. Fig. 1.

rough, which is caused by the great number of shallow foveæ with which the whole surface is thickly covered. This, and the following species, are perhaps the smallest of the genus; at the same time, they are much thicker and stronger in proportion to their size than the other species. The rostrum is short, thick, and suddenly truncated obliquely. The antennæ are minute; the first or superior pair are almost obsolete; they consist of one joint only, which is rhomboidal; the extremity of each is armed with several strong but minute hairs or spines; they arise from the truncated extremity of the rostrum. The inferior antennæ* arise from the inferior surface and base of the rostrum; they are considerably larger than the superior pair; they are five-jointed, the third joint being the longest, the fifth or last is extremely small, and is armed with three very strong pointed and articulated spines. These pair of antennæ are somewhat longer than the rostrum. The foot jaws are rather powerful, and have a great resemblance to the following pairs of feet. The first, or superior pair, are the smallest; the first joint is of considerable length, being equal to all the others combined; it is rather bent and broad, and is armed at its distal extremity with two thumb-like processes or tubercles. Two very long and slender spines, which are almost as long as the foot-jaw itself, arise from the middle part of this segment; the external spine is free of spinules altogether, but the internal is armed, on its external edge only, with a great number of articulated spinules. The second segment of this foot-jaw is very short, and its posterior edge bears two very short articulated spines of equal length; these spines are spiniferous. The third segment is almost equal in length to the first, and, like the second, also gives rise to nine or ten articulated and spiniferous spines. The fourth segment is small and rounded, being also armed on its posterior edge with simple spines. The fifth segment is thumb-like, and spinous on its posterior edge.

The external pair of footjaws are much larger than the internal; they are five jointed, and are armed in the same way as the first pair, except that the external edge of the first segment is armed at regular intervals with small tufts of very fine hairs; the extremity of the second segment is also armed with a very long articulated and spiniferous spine. These two extremities just described are in general lying in such a way as to cover the organs of the mouth.†

The two first pairs of legs are constantly concealed beneath the carapace when the animal is at rest, covering the footjaws and the organs of the mouth, and appear only to be used when the animal is swimming. The anterior or ambulatory division is five-jointed; the first joint is about twice the length of all the others combined; it is considerably bent and very broad; its internal edge is armed at regular intervals with penniciliated tufts of hair; the three following segments are quite free of spines, but the last is armed at its extremity with a strong claw and two smaller spines. An articulated thumb-like and chelate joint

* Plate II. Fig. 5. † Plate II. Fig. 7.

arises from the extremity of the first segment, immediately internal to the four last segments. The natatory or posterior division of this leg is multiarticulate; the two first segments are longest, being equal in length to the first segment of the anterior division; the remaining segments are minute, about nine or ten in number, each of which gives off a very long spiniferous setum, which is articulated at its distal half.* The second thoracic leg of this species presents to us one of those beautiful and delicate structures which it is impossible either to describe or delineate with even a remote degree of accuracy. The ambulatory division is very long and slender, six-jointed; the first joint is long and very much flattened, but tapers from the middle towards its distal extremity, which is armed with a very long and pointed spine; the following joints are all equal to one another in length, except the last, which is minute. The natatory division of this leg is seven or eight-jointed, and is equal in length to the first segment of the other division. The five last segments are all armed with long articulated and spiniferous setæ, which smaller spines are again spinulose.† The four following pairs of legs are simple, that is, they are merely ambulatory; they are all six-jointed, and are very spiny. The segments of the body from which they arise are all ovoid, their dorsal edge being sharp and pointed.‡

The abdominal portion of the body is long and slender, seven-jointed and moniliform; the last joint is minute, and lies between the caudal styles which arise from the extremity of the sixth segment; these styles are of no great length in this species; they are composed of three parts; each style consists of a long jointed peduncle, from the distal extremity of which two biarticulated scales arise; these scales lie one above the other. The first segment of the peduncle is somewhat longer than the sixth abdominal segment; the first segments of the scales are about half the length, and the last segment about one-fourth the length of the peduncle; the inner edge of the superior scales is armed with a number of long, pointed, and articulated spines. The spines which arise from the inner edge of the inferior scales are more numerous; they are all bent, their points being turned backwards; the convex or anterior edges of all these spines are very much serrated. ‖

I have named this species after M. Edwards, the founder of the genus, and the leading crustaceologist of the day.

Cuma Audouinii. Edwards.§

C. With the superior antennæ very small; with the first joint of the ambulatory division of the first pair of legs almost bent at right angles; the terminal joints oval, and the thumb-like process multiarticulate. Long four lines to five. Hab., Frith of Forth.

Description.—Under casual observation this species is very apt to be mistaken for that last described, but by careful examination the difference is

* Plate II. Fig. 10. † Plate II. Fig. 9. ‡ Plate II. Figs. 11, 12.
‖ Plate II. Fig. 13. § Plate II. Fig. 13.

found to be very material. In its general appearance, this species resembles the *Cuma Edwardsii*. The first thoracic segment, however, is longer and not so rounded; the rostrum is shorter and more pointed, and the eyes are larger; the flattened surface on the sides of this species is not so decided. The second thoracic segment is more hid; the third is larger, ovoid, and rounded; the adjoined scale projects backwards; the fourth segment is of the same shape as the third, but not nearly so large; the fifth ends in a sharp point, both superiorly and inferiorly; the sixth thoracic segment is elevate. The superior antennæ are very small, and scarcely to be distinguished from the rostrum. The inferior antennæ are very similar to those of the *Cuma Edwardsii*. The foot-jaws are also similar in their structure to those of the last described species; the ambulatory division of the first leg is five-jointed; the first-joint is very much bent, and is of considerable breadth; the two last joints are quite oval, and the last nonchelate. The internal thumb-like process, instead of being composed of one-joint only, as in the last described species, consists of four or five segments, which are all armed with short spiniferous and pointed spines; the natatory portion of this leg is multiarticulate, the extreme joints being very small, so as to place the long spiniferous setæ very close to one another.*

The second pair of legs are very short.† The four last pairs of legs are similar in their structure to those of the last described species. The abdomen and caudal fins also bearing a similar resemblance.

This species is apparently the Cuma Audouinii of M. Edwards, but whether it is or not I cannot be quite certain.

Cuma trispinosa, mihi.‡

C.—With the dorsal ridge of the carafface surmounted by three spines, with the ambulatory division of the first pair of legs extremely short, and with the second thoracic segment well developed. Long, 8 lines. Hab., Frith of Forth.

Description.—This is a most characteristic species, and brings out several points of material consequence in the character of the genus. This species has the body quite smooth, and of the same colour as the preceding. It is the largest of all the species, but is more slender. The thoracic segments are not so deep as those of the preceding species, and the lateral compression is awanting. The rostrum is sharp-pointed, and bent considerably upwards; the eyes are small, and the dorsal ridge immediately behind the eye is surmounted with three thick short spines. The second thoracic segment is of considerable extent at its dorsal part, but is quite obsolete at the middle; it again, however, makes its appearance at its inferior part, where it supports the second pair of compound legs. The four following segments gradually decrease in size:—The superior antennæ are of considerable size, oblong and spinous. The inferior antennæ are much longer than the rostrum. The ambulatory division of the first pair of legs is extremely short, and

* Plate II. Fig 19. † Plate III. Fig. 1. ‡ Plate IV. Fig. 16.

the first joint is of no great breadth. The natatory division is about the same length as the first joint of the anterior division.*

The second pair of legs are very long and slender; the first segment is not broader than the following joints, and is armed internally at its extremity with a very long spine.†

The simple feet are extremely spiny.‡

The abdominal portion of the body is very long and slender, the fifth segment being the longest. The caudal styles are long, slender, and pointed; the internal scale has the last joint pointed and armed with two spines; the last segment of the external scale is more obtuse. ||

Genus Alauna, mihi.[1]

Generic Characters.—The superior antennæ are composed of a peduncle and a multi-articulate filament. The inferior antennæ are eight-jointed. The three first pair of legs are compound. The internal scale of the caudal style is composed of three segments, and the external of one.

Alauna rostrata, mihi.

Description.—The whole animal is of a beautiful bright straw colour, inclining to yellow. The thoracic portion of the body is very large and swollen. The first segment or carapace is almost oval. The rostrum is long, pointed, and is bent upwards at its extremity. The eyes, which are of considerable size, are situated at the base of the rostrum. The superior pair of antennæ are very slender, consisting of a delicate filament covered with hairs, which arises from a short peduncle; these antennæ are almost equal in length to the rostrum.[2]

The inferior antennæ are much longer, consisting of eight joints slightly spinous; the distal extremity of the third is armed with a strong multi-articulate spine.[3] The foot-jaws are seen projecting considerably beyond the edge of the carapace; they are very spiny, and the last joint but one is armed with a long articulated spiniferous spine.[4]

The first pair of legs are extremely short; the thumb-like process at the extremity of the ambulatory division is single-jointed and spiniferous.[5] The second pair of legs are also short.[6] The ambulatory division of the third pair of legs is very long and slender, being almost as long as that of the second pair of legs; the fifth joint is the longest. The natatory division is as long as the first four joints of the ambulatory.[7] The simple legs are very spiny on their anterior edges.[8]

The abdomen is short and thick, seven-jointed, the last joint being produced into a long spine which is spiniferous on either edge; the anal aperture is seen near the base of this segment. The caudal styles arise from the sixth segment, and they are much more complicated than those of the foregoing genera. The first segment is slightly clavate, longer than the seventh abdominal segment, and armed with a single

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* Plate III. Fig. 3. † Plate III. Fig. 4. ‡ Plate III. Fig. 6.
|| Plate III. Fig. 5. [1] Plate IV. Fig. 1. [2] Plate IV. Fig. 3.
[3] Plate IV. Fig. 4. [4] Plate IV. Fig. 5. [5] Plate IV. Fig. 6.
[6] Plate IV. Fig. 7. [7] Plate IV. Fig. 9. [8] Plate IV. Fig. 8.

row of spines on its inner edge. The internal scale consists of one joint only; it is very spiny, and is about half the length of the external. The external scale is composed of three joints, the two first of which are equal in length to one another; the third is about twice the length of both of these, and is very spiny at its extremity.

Long, half-an-inch. Hab., Frith of Forth.

Having only obtained one specimen of *Alauna rostrata*, and one also of *Bodotria arenosa*, I have not been able to examine the structure of these two genera satisfactorily.

Genus Bodotria, mihi.

Generic Characters.—The first, second, third, fourth, and fifth abdominal segments are each armed with a pair of bifurcated finlets. The two terminal scales of the caudal styles are single-jointed.

Bodotria arenosa, mihi.

Description.—The carapace is almost oval, rostrum awanting, that part of the carapace being merely rounded off. The superior antennæ are quite obsolete. The inferior pair are of considerable length, and are terminated by means of two long spines.

The ambulatory division of the first pair of legs has the first joint of a very great size, being very much flattened and slightly curved. The four remaining joints, together with the internal thumb, are very spiny. The natatory division of the leg is six-jointed, the four last joints giving rise to as many long spiniferous spines, which are articulated at their distal halves. The external edge of these spines are spiniferous at the articulated half only. The ambulatory division of the second pair of legs has the first segment very broad, and tapering gradually towards its distal extremity, from which arises a very long, articulated, and spiniferous spine.

The abdominal finlets are five in number. They are composed of two parts, viz., the first or pedicle, and the second or bifurcation; the pedicle is of considerable length, from the extremity of which there arises two scales, which are armed on their margins with long spiniferous spines, which are much longer than the finlet itself.

The first segment of the caudal styles tapers very slightly, and the two terminal scales are each of them single-jointed, and end by means of very fine points. The external is armed at its extremity with two spines. Long, 5 lines.

This genus forms doubtless a link between the *Stomapoda* of M. Edwards and the higher Crustacea.

In their habits all these animals seem to agree. I have not been able to observe any thing peculiar in them. They swim with very great rapidity, and on stopping they fall to the bottom on the sand or gravel, without attempting to lay hold of anything, as I have already remarked, seldom using their feet